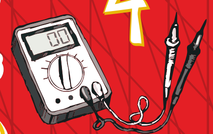
Unit 4



Introduction to Energy Meter

Introduction

Do you have an electricity connection at your home? If yes, you must have seen that an energy meter is installed at your premise and a person comes to your home to take a reading every month. The energy meter is an electrical measuring device, which is used to record electrical energy consumed over a specified period of time in terms of units. Every house, small factory, business establishment, shops, offices, etc., needs at least one energy meter to register power consumption. The supplier of electrical energy raises the bill on the basis of reading shown by this meter. The consumer needs to pay the amount against the bill raised by the supplier.

Session 1: Importance of Energy Meter

Energy Meters

A meter is a device suitable for measuring, indicating and recording consumption of electricity or any other quantity related to an electrical system (Fig. 4.1). It also includes, wherever applicable, other instruments, such as current transformer (CT), voltage transformer (VT) or capacitor voltage transformer (CVT) necessary for such purpose.

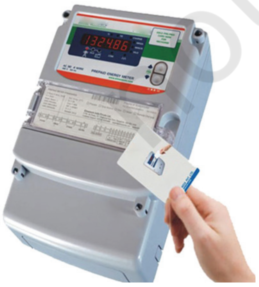


Fig. 4.1 Energy meter

Power companies or state electricity board install energy meters at every place where electricity is consumed, such as residential places, industries, commercial organisations to measure the electricity consumption.

The basic unit of power is watts. One-thousand watts is one kilowatt. If we use one kilowatt in one hour, it is considered as one unit of energy consumed. These meters measure the instantaneous voltage and currents, calculate its product and give instant power. This power is integrated over a period which gives the energy utilised over that time period.

Basic Types of Energy Meters

Energy meter or watt-hour meter is classified in accordance with several factors, such as

- type of display like analog or digital electric meter,
- type of metering point like grid, secondary transmission, primary and local distribution,
- end applications like domestic, commercial and industrial and
- technical like three-phases, single-phase, HT, LT and accuracy class meters.

Electromechanical induction-type energy meter

It is the most common type of age old watt-hour meter. It consists of a rotating aluminium disc mounted on a spindle between two electromagnets. Speed of rotation of disc is proportional to the power and this power is integrated by the use of counter mechanism and gear trains. It comprises two silicon steel laminated electromagnets, i.e., series and shunt magnets (Fig. 4.2).

Series magnet carries a coil which is of few turns of thick wire connected in series with line whereas shunt magnet carries a coil with many turns of thin wire connected across the supply.

Breaking magnet is a permanent magnet which applies the force opposite to normal disc rotation to move that disc at a balanced position and to stop the disc while power is off.

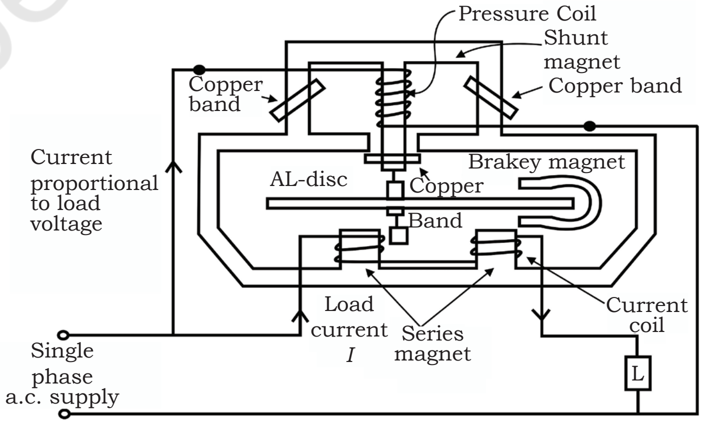


Fig. 4.2 Electromechanical meter

Series magnet produces the flux which is proportional to the current flowing and shunt magnet produces the flux proportional to the voltage. These two fluxes lag by 90 degrees due to inductive nature. The interaction of these two fields produces eddy current in the disc, exerting a force, which is proportional to the product of instantaneous voltage, current and phase angle between them.

Vertical spindle or shaft of the aluminium disc is connected to gear arrangement which records a number, proportional to the number of revolutions of the disc. This gear arrangement sets the number in a series of dials and indicates energy consumed over a time. This type of meter is simple in construction and accuracy is somewhat less due to creeping and other external fields. A major problem with these types of meters is that they are prone to tampering easily. This has led to the requirement of an electrical energy monitoring system. These are very commonly used in domestic and industrial applications.

Electronic energy meters

These are accurate, high procession and reliable type of measuring instruments as compared to conventional mechanical meters. They consume less power and start measuring instantaneously when connected to load. These meters might be analog or digital. In analog meters, power is converted to proportional frequency or pulse rate and it is integrated by counters placed inside it. In a digital electric meter the power is directly measured by a high-end processor. The power is integrated using logic circuits to get the energy and also for testing and calibration purpose. It is then converted to frequency or pulse rate.

Analog electronic energy meters

In analog type meters, voltage and current values of each phase are obtained by voltage divider and current transformers, respectively, which are directly connected to the load as shown in Fig. 4.3.

These analog values are converted to corresponding frequency signals by frequency converter. These frequency pulses then drive a counter mechanism where these

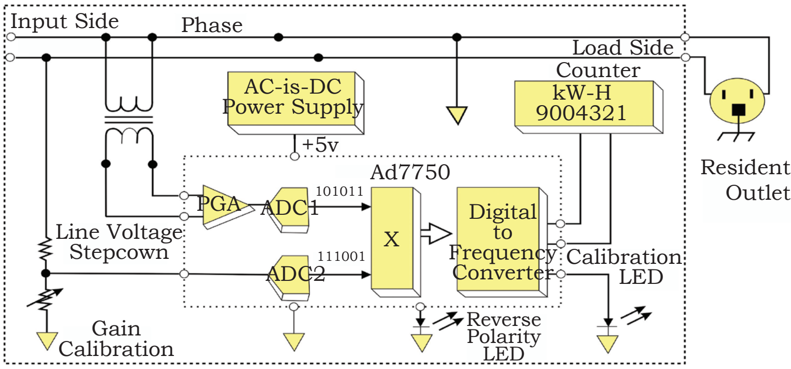


Fig. 4.3 Analog energy meter

values are integrated over a time to produce the electricity consumption.

Electromechanical meters were replaced by the analog electronic energy meters. The electromechanical meter’s disc as well as counter can easily be tampered and there are chances of theft of energy as well.

Digital electronic energy meters

Digital signal processor or high performance microprocessors are used in digital electric meters. Similar to the analog meters, voltage and current transducers are connected to a high resolution ADC. Once it converts analog signals to digital samples, voltage and current samples are multiplied and integrated by digital circuits to measure the energy consumed (Fig. 4.4).

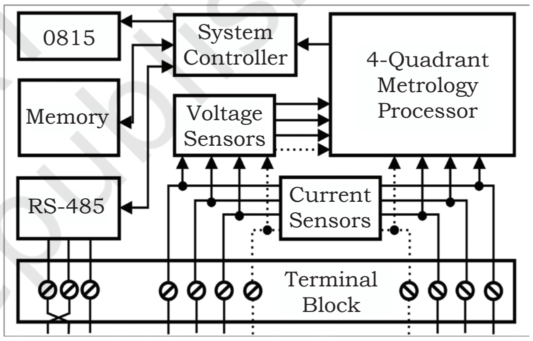


Fig. 4.4 Digital electronic energy meters

The microprocessor also calculates phase angle between voltage and current, and also measures and indicates reactive power. It is programmed in such a way that it calculates energy according to the tariff and other parameters like power factor, maximum demand, etc., and stores all these values in a non-volatile memory EEPROM (Electrically Erasable Programmable Read-only Memory).

It contains real time clock (RTC) for calculating time for power integration, maximum demand calculations and also date and time stamps for particular parameters. Furthermore, it interacts with the liquid crystal display (LCD), communication devices and other meter outputs. Battery is provided for RTC and other significant peripherals for backup power.

Today, analog electronic meters have been replaced with digital electronic energy meters, because there is least chance of energy theft due to digital display unit.

Smart energy meters

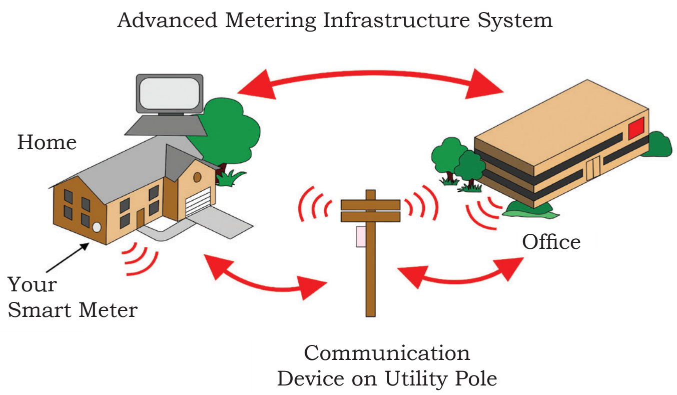
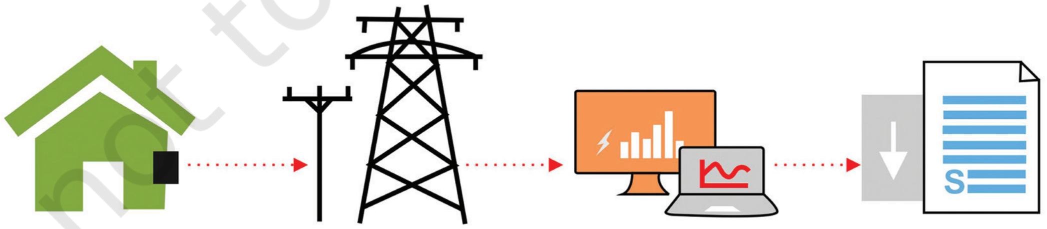

Advanced Metering Infrastructure System
Home
Office
Your Smart Meter
Communication Device on Utility Pole

Fig. 4.5 Smart energy meters

It is an advanced metering technology involving placing intelligent meters to read, process and provide feedback to customers. It measures energy consumption, remotely switches the supply to customers and remotely control the maximum electricity consumption. Smart metering system (Fig. 4.5) uses the advanced metering infrastructure system technology for better performance.

This system is capable of communicating in both directions. It can transmit data to the utilities like energy consumption, parameter values, alarms, etc., and can also receive information from utilities, such as automatic meter reading system, reconnect or disconnect instructions, upgrading of meter softwares and other important messages. These meters reduce the need to visit for taking or reading monthly bill. Modems are used in these smart meters to facilitate communication systems, such as telephones, wireless, fiber cables, power line communications (Fig. 4.6). Another advantage of smart metering is that it can help prevent tampering of energy meter, where there is scope of using power in an illegal way.



Your smart meter measures and records electricity usage every 30 minutes

Data is transmitted to electricity distributors who own and manage the grid, poles and wires

Energy providers make consumption data availbale to you, via web portal or in-home display

You can monitor your household's energy usage, to help compare offers and better manage costs

Fig. 4.6 Data transfer from smart meter

Smart meters are installed in big installations like cinema halls, showrooms, industrial plants where load is less than 100 HP.

Check Your Progress

A. Fill in the Blanks

1. Data is transfered through ____________ in smart meter.
2. Electrical energy is measured by ______________
3. ______________ is called age old watt-hour meter.
4. 1000 watts is equal to ______________

B. Multiple Choice Questions

1. If we consume 2000 watts for an hour, the total unit consumed is ______________.
   (a) 2 units
   (b) 1 units
   (c) 0.5 units
   (d) 0.2 units
2. In smart meters, to facilitate communication we use ______________.
   (a) telephone
   (b) mobile
   (c) modem
   (d) direct line
3. Basic form of energy meter is ______________.
   (a) electronic meter
   (b) electromechanical meter
   (c) analog meter
   (d) digital meter

C. Write Short Notes on

1. Digital meter
2. Smart energy meter
3. Electronic energy meter

SESSION 2: TYPES OF METERS

Various types of meter are installed for various purpose as per requirement.

Single-phase Meter

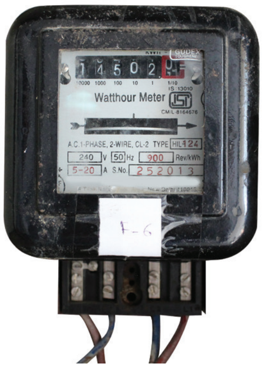


Fig. 4.7 Single-phase meter

They are directly connected to the mains. These meters have a simple, compact and robust design with outstanding performance and characteristics (Fig. 4.7). Single-phase meters are rated for 240V AC supply, current rating is 2.5–10A, 10–60A or 20–80A (max).

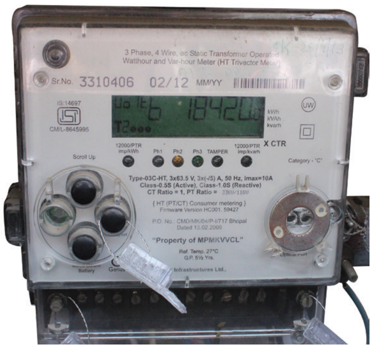


Fig. 4.8 Three-phase meter

Three-phase Whole Current Meter (Polyphase Meter)

These meters are directly connected to the supply if load is up to 50A in LT system for sanctioned load up to 25 kW. Polyphase whole current meter is three-phase four wire meter which is a combination of three single-phase meters. The entire load current to be measured passes through the meter itself. They are rated for 415 volts (Fig. 4.8).

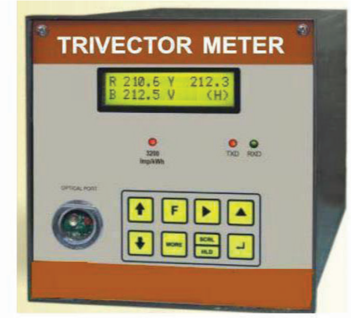


Fig. 4.9 Trivector meter

HT Meter (Trivector Meter)

The HT or Trivector meter is a measuring instrument which measures the active power, reactive power and total energy consumed of a power line (Fig. 4.9). Trivector meters are usually used in substations or for billing power drawn by industrial consumers.

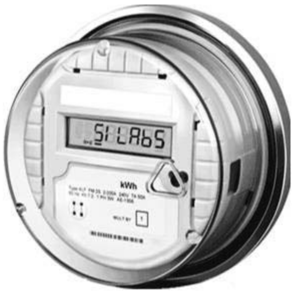


Fig. 4.10 Smart meter

Smart Meter

Smart meters are the next generation of electricity meters and offer a range of intelligent functions (Fig. 4.10).

For example, these meters record how much energy you are using through a display in your home. These meters can also communicate directly with your energy supplier that means no one will need to come and read your meter at home or office premises.

Most of the smart meters that are being installed today use a SIM card to send meter readings to your supplier, and other wireless technologies to send information to the in-home display.

It measures and records how much electricity a household or business is using at 30-minute intervals. There are different smart meter models available, but the basic functions are the same.

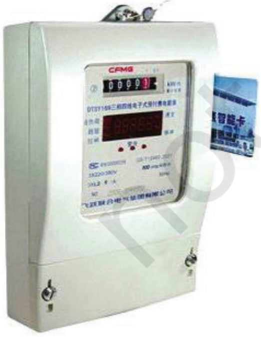


Fig. 4.11 Prepaid meter

Prepaid Meter

A prepayment or prepaid meter lets you pay for your energy before you use it. It is an excellent way to keep track of how much you are spending and can help you budget for your energy bills (Fig. 4.11).

In other words, you pay for your energy up front instead of by quarterly bill or monthly direct debit. And if there is no credit in the meter, there is no energy supply to the home.

A prepayment meter can help you to make a budget for your energy bills, but it can also be one of the most expensive ways to pay for electricity.

Duties and Responsibilities of Consumer Energy Meter Technician Working in a Power Distribution Company

The Consumer Energy Meter Technician installs, removes and changes low voltages, single-phase or three-phase consumer energy meters and also HT meters and supportive equipment at works site in accordance with the guidelines of Discoms (State Power Utilities and Private Distribution Companies).

In some of the Discoms, the power of recruitment for consumer energy meter technicians are delegated to the concerned Engineer In-charge of the Circle.

The Consumer Energy Meter Technician is allowed to work on a live line, however it is mandatory that they possess a competency certificate issued by the Electrical Inspector.

(a) The jurisdiction of Consumer Energy Meter Technician (CEMT) is fixed by the Assistant Engineer (AE)/Assistant Manager (AM) in writing. The Helpers coming in the area are subordinate to the Consumer Energy Meter Technician, if so specified. The Consumer Energy Meter Technician will be responsible for all the meter related works done under his jurisdiction. Any negligence and consequent losses will be treated as negligence of their duties.

(b) The CEMT shall know all the network details within their jurisdiction, such as length of HT and LT lines and telephone lines, type of conductors, spans, number of distribution transformers and number of service and their connected load, etc.

(c) The CEMT shall be responsible for proper ground clearance of all service connections in their area.

It is their responsibility to intimate their next superior in writing about the defects noticed by them in the distribution.

(d) The Consumer Energy Meter Technician shall be responsible for maintaining continuity of supply to the consumer in their jurisdiction.

(e) They shall be responsible for upkeep of (Tools and Plant) and safety appliances supplied to them and keep them in working order.

(f) They are responsible for maintaining the proper gradation of fuses in all service connections.

(g) A certificate has to be given regarding inspection of services under their charge, stating that the connected load, tariff, meters and other properties of Board are safe.

(h) They shall maintain a register showing the details of new energy meters issued, replaced, burnt meters, meters waited for testing and meter-related complaints of slow, fast and defective meters and details of meter seals with numbers, fixation.

(i) They shall maintain diaries showing the daily work done and get the signatures of their superiors once in a fortnight.

(j) Any field complaints or defects shall be recorded in the register kept at the Section office and no other plea of the staff brought to the notice of Section Officer orally will be entertained.

(k) The CEMT should also maintain a register showing all the statistics and details of services, lines, transformers and equipment. They shall also possess maps of these lines, with location numbers, cut points and geographical features, etc., supplied by the Section Officer.

(l) They shall associate with meter testing schedules, after completing the testing of each connection and handover the report to their superiors.

(m) They shall be responsible to ensure that the code of safety rules is followed by them and their colleagues. A copy of the said code is already supplied to them.

Any instances where the staffs fail to use safety appliances as per the code shall be brought to the notice of their superiors immediately for taking disciplinary action.

The above functions are broad, general indication of a Consumer Energy Meter Technician's functions. In addition to the above, the line staff has to perform the role expected of them in the respective Distribution Companies with which they are associated.

NOTES

Consumer Meters

The consumer meter shall be installed by the licensee either at consumer premises or outside the consumer premises:

(a) Provided that where the licensee installs the meter outside the premises of the consumer, the licensee shall provide real-time display unit at the consumer premises for information to indicate the electricity consumed by the consumer.

(b) Provided further that for the billing purpose, reading of consumer meter and not the display unit shall be taken into account.

In the event the appropriate Commission allows supply of electricity directly from a generating company to consumer on a dedicated transmission system, the location of the meter will be as per their mutual agreement.

Regulation of Central Electricity Authority

In exercise of the powers conferred by sub-section (1) of section 55 and clause (e) of section 73 read with sub-section (2) of the section 177 of Electricity Act, 2003, the Central Electricity Authority hereby makes the following regulations for managing the installation and operation of meters:

Short Title and Commencement

These regulations are called the Central Electricity Authority (Installation and Operation of Meters) Regulations, 2006.

These regulations came into force on the date of their publication in the Gazette of India.

Applicability of Regulation

(i) These regulations shall be applicable to meters installed and to be installed by all the generating companies and licensees who are engaged in the business of generation, transmission, trading, distribution, supply of electricity and to all categories of consumers.

(ii) After coming into force of these regulations, the provisions of the Indian Electricity Rules, 1956, related to installation and operation of meters in this regard, shall not be applicable.

These regulations provide for type, standards, ownership, location, accuracy class, installation, operation, testing and maintenance, access, sealing, safety, meter reading and recording, meter failure or discrepancies, anti-tampering features, quality assurance, calibration and periodical testing of meters, additional meters and adoption of new technologies in respect of the following meters for correct accounting, billing and audit of electricity.

Types of Meters

(i) All interface meters, consumer meters (Fig. 4.12) and energy accounting and audit meters shall be of static type.

(ii) The meters not complying with these regulations shall be replaced by the licensee on their own or

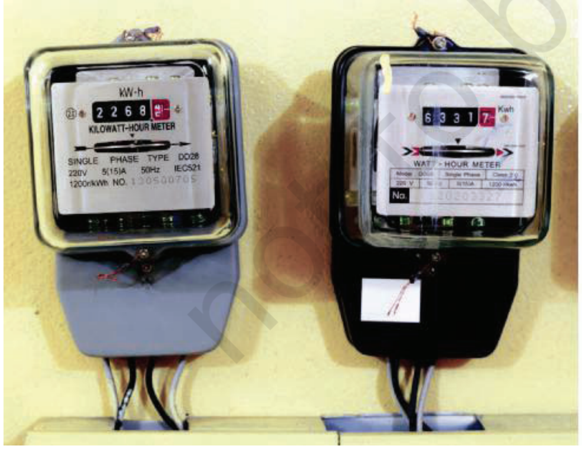


Fig. 4.12 Consumer meter

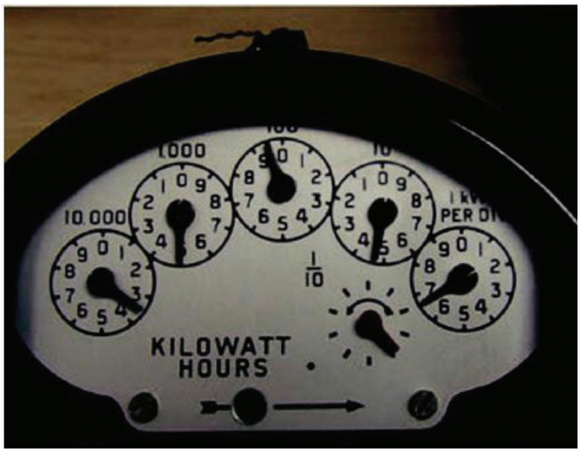


Fig. 4.13 Analog meter

on request of the consumer. The meters may also be replaced as per the regulation or direction of the appropriate commission or pursuant to the reforms programme of the appropriate government.

Standards

All interface meters, consumer meters and energy accounting and audit meters shall

(i) comply with the relevant standards of Bureau of Indian Standards (BIS). If BIS Standards are not available for a particular equipment or material, the relevant British Standards (BS), International Electrotechnical Commission (IEC) Standards, or any other equivalent Standard shall be followed.

(ii) provide that whenever an International Standard or IEC Standard is followed, necessary corrections or modifications shall be made for nominal system frequency, nominal system voltage, ambient temperature, humidity and other conditions prevailing in India before actual adoption of the said standard.

(iii) conform to the standards on 'Installation and Operation of Meters' as specified in schedule annexed to these regulations and as amended from time to time.

All consumer meters shall bear BIS mark, meet the requirements of these regulations and have additional features as approved by the appropriate Commission or pursuant to the reforms programme of the appropriate government. To facilitate this, the licensee shall provide a list of makes and models of the meters.

Location of Meter Installation

The location of meter installation is very important to minimise the incidents of theft, malpractice and for easy approach and comfortable meter reading.

The benefits include

1. less temptation to bypass,
2. discouraged meter tampering activity and
3. easy meter reading.

The location of an electricity meter varies with each installation. The possible locations include a utility pole serving the property, in a street-side cabinet (meter box) or inside the premises adjacent to the consumer unit or distribution board. Electricity companies may prefer external locations as the meter can be read without gaining access to the premises or the meter location should be at the door step and should be installed not more than 5 feet high.

Current transformers permit the meter to be located remotely from the current-carrying conductors. This is common in large installations. For example, a substation serving a single large customer may have metering equipment installed in a cabinet, without bringing heavy cables into the cabinet.

Check Your Progress

A. Write Short Notes on

1. Electromechanical meter
2. Consumer meter
3. Smart meter

B. Fill in the Blanks

1. A ____________ meter lets you for your energy before you use it.
2. In India ____________meters were used in olden times.
3. Smart meters use a ____________ to send meter readings.

SESSION 3: INSTALLATION OF METERS

Electricity meters are required to register the energy consumed within an acceptable degree of accuracy. Any significant error in the registered energy can represent a loss to the electricity supplier, or the consumer being over billed. The accuracy is generally laid down in statute for the location in which the meter is installed. Statutory provisions should also specify a procedure to be followed should the accuracy be disputed.

Every meter is tested in a meter testing lab for checking its accuracy and a certificate is issued before installing the meter at consumer premises.

NOTES

In India, any installed electricity meter is required to accurately record the consumed energy, but it is permitted to under-read by 5%, or over-read by 5%. Disputed meters are initially verified with a check meter operating alongside the disputed meter. The final resort is for the disputed meter to be fully tested both in the installed location and at a specialist calibration laboratory.

The disputed energy meters are removed from the premise and properly sealed with the signature of the consumer before sending it to the laboratory for testing. After testing the energy meter the lab issues a certificate regarding the percentage slow and fast for billing.

Approximately 93% of the disputed meters are found to be operating satisfactorily. A refund of electricity paid for, but not consumed (but not vice versa) will only be made if the laboratory is able to estimate how long the meter has been misregistering.

Installation of Meters

The installation of meters includes the steps given below.

1. Distribution company or licensee, as the case may be, shall examine, test and regulate all meters before installation and only faultless meters shall be installed.
2. The meter shall be installed at locations, which are easily accessible for installation, testing, commissioning, reading, recording and maintenance. The place of installation of meter shall be such that minimum inconvenience and disruptions are caused to the site owners and the concerned organisations.
3. In case of single-phase meters, the consumer shall ensure that there is no common neutral or phase or looping of neutral or phase of two or more consumers on consumer's side wiring. If such common neutral or phase or looping of neutral or phase comes to the notice of the licensee, they shall suitably inform the consumer through installation report or regular electricity bills or meter test report as applicable.

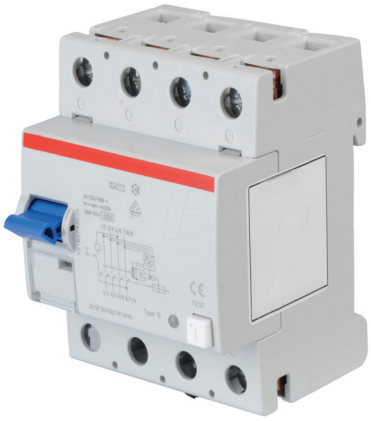


Fig. 4.14 Earth leakage circuit breaker

4. Consumer shall install the Earth Leakage Protective Device (ELPD) (Fig. 4.14) in accordance with the provisions of the rules or regulations in this regard.
5. If the earth leakage indication is displayed in the meter, the licensees shall suitably inform the consumer through installation report or regular electricity bills or meter test report as applicable.
6. In case CTs (Current Tranformers) and VTs (Voltage Tranformers) form part of the meters, the meter shall be installed as near the instrument transformers as possible to reduce the potential drop in the secondary leads.

Installation of Different Energy Meters

How to connect Single-phase Energy Meter (1-phase, 2 Wire)?

Fig. 4.15 shows the connection of single-phase (1-phase, 2 Wire) kWh meter (Digital or Analog Energy Meter) from the supply to the main distribution board. The red wire shows the live or line or phase and the black shows the neutral wire.

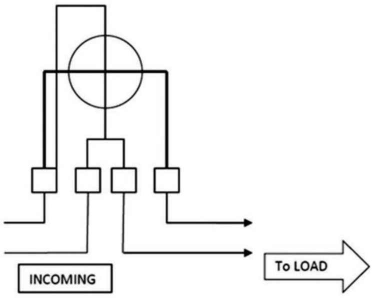


Fig. 4.15 Single-phase whole current meter (Connection Diagram)

Single-phase Whole Current Meter

1. Various LED indicators are present on the meter, i.e., constant, pulse, ELT (earth load tamper).
2. If the power is ON, the constant pulse will show a constant indication, as the name suggests.
3. If the load is ON, the pulse indicator will blink. As specified on the meter box, a certain number of pulses will make a unit. For example, there are meters with 6400, 3400, 1200, etc., pulses per hour. For a typical meter having specifications of 3200 pulses, it will record 1 unit if 1 kW is used for 1 hour.
4. The ELT LED will be blinking in the tampered or unusual condition when there is a leakage of current through earth. This, additionally, indicates that the current is getting a separate return path through earth rather than the meter.
5. The LED indicating REV (Revolution) will be blinking in case of tampered or unusual conditions when there is a reverse current flowing through the meter. For example, if 5A is flowing through the phase wire, 8A is returning through neutral wire.

How to Connect 3-phase 4-wire Energy Meter

Three-phase or Poly-Phase (3-phase, 4 Wire) (Digital or Analog Energy Meter) from the supply to the main distribution board (Fig. 4.16).

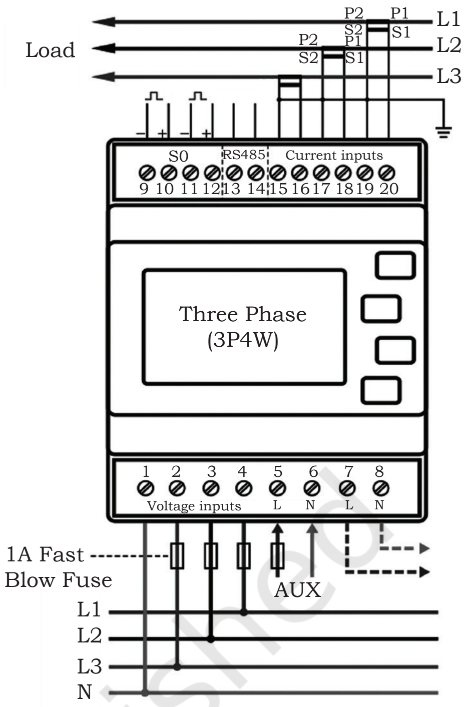


Fig. 4.16 Three-phase Whole Current Meter (Connection Diagram)

Low Tension Current Transformer (LT CT) Meter (3-Phase 4-Wire Meters with CTs)

CTs are available in the ratio of 50, 100, 200, 300; 400/5A. CT has to be accurately selected for consumer meter. Rating of CTs should fall within 50 to 80% of the maximum load current of the consumer. The polyphase meters are provided with maximum demand indicators (MDI), which are additional mechanisms attached to the meters to record the rate of consumption over a fixed period each time (30 minutes). Higher rating CTs say 800, 1000, 1200, 1500, 2000/5A are commonly used for energy audit as distribution transformer meters.

Three-Phase Whole Current Meter (Electronic Meter)

These meters are used in conjunction with current transformers, as here the value of load current is so high that the meter cannot withstand it directly (Fig. 4.17).

While calculating, the multiplying factor is taken as unity considering that the rating of CTs connected match with the energy meter. In case different ratio CTs are used, MF is additionally added.

For example, if LT CT meters are rated CTR 60/5A, 100/5A and 200/5A and they are connected with identical CTs of ratio 60/5A, 100/5A and 200/5A, MF will always remain 1.

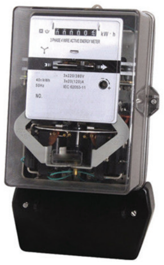


Fig. 4.17 Three-phase four-wire meter with CT

Installation of LT CT Operated Meter

Ensure all current transformers are installed as per the wiring diagram (which can also be found under the terminal cover of the meter), the correct polarity of current transformers is essential, i.e., (p1 facing mains) and (p2 facing load) (Fig. 4.18). Check if ALL S1 and S2

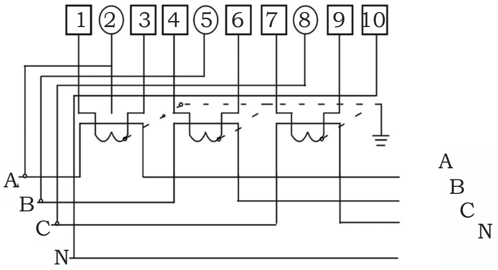
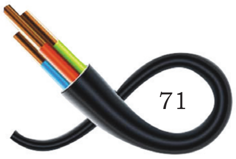


Fig. 4.18 Installation Phase 4 Wire CT Operated Meter



connections are correct as per wiring diagram otherwise there will be problems with the register displays. For health and safety reasons it should be noted that if a current transformer is operated with the secondary (S1 and S2) open circuited, dangerous voltages may be generated at the secondary terminals or leads.

Installation Notes

To ensure that the meter reads correctly installation should be done as follows:

1. Connect the meter according to the wiring instructions (which can be found inside the terminal cover). Note the voltage inputs to the meter must be externally fused and terminal 11 is the neutral, tying down the three voltages.
2. The CT cables should be kept as short as possible, use 2.5mm cable to maintain accuracy.
3. CTs match the ratio of the meter being fitted (e.g., 200/5 amp meter = 200 amp CTs.)
4. CTs must be fitted on to the cable the correct way round so that (P1) side is towards the mains and (P2) is facing the load.
5. The cables from the CTs must be connected the correct way round observing (S1) and (S2) markings on the meter and the CT.
6. Always connect (S1) to the first terminal of the phase and (S2) to the third terminal. The smaller middle terminal is for a voltage connection from that phase.
7. Check the RST indicator, this should be on — if it is ‘off’ one or more phase voltages is missing — if it flashes the phases are in the wrong order, two will have to be swapped over (the CT wires will also have to be moved to keep them with the right voltage).
8. Check if the meter is operating in the correct direction — the arrow symbol (or disc, if disc driven) should show left to right. Open all the voltage fuses then try one phase at a time and check if each phase makes the meter go in the correct direction.
9. Check the red light, it should flash if power is being measured.

Access to Meter

The owner of the premises, where the meter is installed, shall provide access to the authorised representative(s) of the licensee for installation, testing, commissioning, reading and recording and maintenance of meter (Fig. 4.19).

Fig. 4.19 Concerned person checking the meter

Sealing of Meters

Sealing Arrangements

All meters shall be sealed by the manufacturer at its works. In addition to the seal provided by the manufacturer at its works, the sealing of all meters shall be done at various sealing points as per the standards given in the schedule below:

1. Sealing of interface meters, shall also be done by both the supplier and the buyer.
2. Sealing of consumer meters shall also be done by the licensee.
3. Sealing of energy accounting and audit meters shall be done by licensee or generating company.
    - (a) A tracking and recording software for all new seals shall be provided by the manufacturer of the meter so as to track the total movement of seals starting from manufacturing, procurement, storage, record keeping, installation, series of inspections, removal and disposal.
    - (b) The seal shall be unique for each utility, and name or logo of the utility shall be clearly visible on the seals.
    - (c) Only the patented seals (seal from the manufacturer who has official right to manufacture the seal) shall be used.
    - (d) Polycarbonate or acrylic seals or plastic seals or holographic seals or any other superior seal shall be used.
    - (e) Lead seals shall not be used in the new meters. Old lead seals shall be replaced by new seals in a phased manner and the time frame of the same shall be submitted by the licensee to the appropriate Commission for approval.

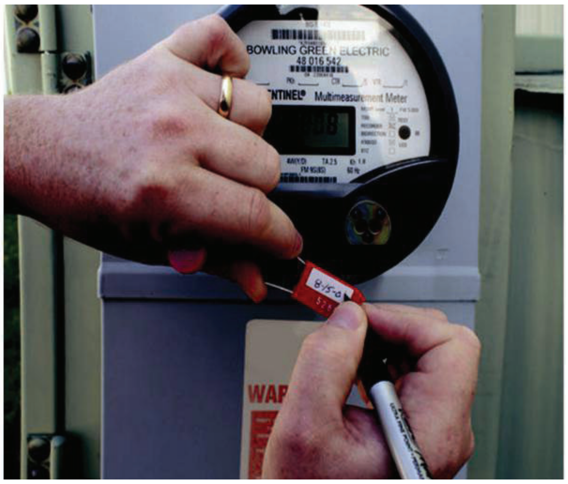


Fig. 4.20 Sealing meter

Removal of Seals from Meters

Seal of the consumer meter shall be removed only by the licensee. No consumer shall tamper with, break or remove the seal under any circumstances. Any tampering, breaking or removal of the seal from the meter shall be dealt with as per relevant provisions of the Act (Fig. 4.20).

Meter Failure or Discrepancies

In case the consumer reports to the licensee about consumer meter readings as not commensurate with their consumption of electricity, stoppage of meter, damage to the seal, burning or damage of the meter, the licensee shall take necessary steps as per the procedures given in the Electricity Supply Code of the appropriate Commission read with the notified conditions of supply of electricity.

Quality Assurance of Meters

1. The distribution licensee shall put in place a system of quality assurance and testing of meters with the approval of an appropriate Commission.
2. The licensee shall set up appropriate number of accredited testing laboratories or utilise the services of other accredited testing laboratories. The licensee shall take immediate action to get the accreditations of their existing meter testing laboratories from NABL, if not already done.
3. The generating company or licensee shall ensure that all type, routine and acceptance tests are carried out by the manufacturer complying with the requirement of the relevant IS or BS or IEC as the case may be.

Calibration and Periodical Testing of Meters

Consumer Meters

The testing of consumer meters is done at site at least once in five years. The licensee may, instead of testing the meter at site, remove the meter and replace the same by a meter duly tested in an accredited test laboratory (Fig. 4.21). In addition, meters installed in the circuit shall be tested if study of consumption pattern changes drastically from the similar months or season of the previous years or if a consumer complaints about a meter. The standard reference meter of better accuracy class than the meter under test shall be used for site testing of consumer meters up to 650 volts. The testing for consumer meters above 650 volts should cover the entire metering system including CTs and VTs. Testing may be carried out through NABL accredited mobile laboratory using secondary injection kit, measuring unit and phantom loading or at any accredited test laboratory and recalibrated if required at manufacturer's works.

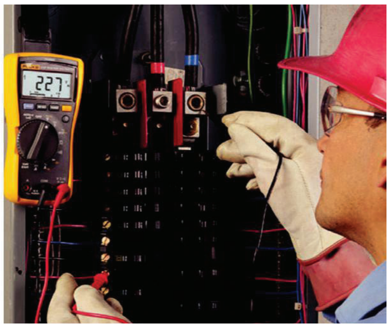


Fig. 4.21 Calibration of electric meters

Additional Meters

In addition to any meter which may be placed for recording the electricity consumed by the consumer, the licensee may connect additional meters, maximum demand indicator or other apparatus. These can be used to ascertain or regulate either the quantity of electricity supplied to the consumer, or the number of hours during which the supply is given, or the rate per unit of time at which energy is supplied to the consumer, or any other quantity or time connected with the supply to consumer:

- provided that the meter, indicator or apparatus shall not, in the absence of an agreement to the contrary, be placed otherwise than between the distributing mains of the licensee and any meter.
- provided further that, where the charges for the supply of energy depend wholly or partly upon the reading or indication of any such meter, indicator or apparatus as aforesaid, the licensee shall, in the absence of an agreement to the contrary, keep the meter, indicator or apparatus correct.

Adoption of New Technologies

The distribution licensee shall make out a plan for introduction and adoption of new technologies, such as prepaid meters, time of the day meters (TOD), automatic remote meter reading system through appropriate communication system with the approval of the appropriate Commission or as per the regulations or directions of the appropriate Commission or pursuant to the reforms programme of the appropriate government.

Standards Common to All Types of Meters

These standards provide for specification of meters, immunity to external factors, sealing points and functional requirements that are required from a regulatory perspective. Detailed technical specification shall be prepared by the purchaser of the meter.

The meter shall have downloading facilities of metered data through Meter Reading Instrument (MRI).

Immunity to External Factors

The meter shall be immune to external influences like magnetic induction, vibration, electrostatic discharge, switching transients, surge voltages, oblique suspension and harmonics; and necessary tests shall be carried out in accordance with relevant standard.

Sealing Points

Sealing shall be done at the following points (as applicable):

(a) Meter body or cover
(b) Meter terminal cover
(c) Meter test terminal block
(d) Meter cabinet

The accuracy class of current transformers (CTs) and voltage transformers (VTs) shall not be inferior to that of associated meters. The existing CTs and VTs not complying with these regulations shall be replaced by new CTs and VTs, if found defective, non-functional or as per the directions of the appropriate Commission. In case the CTs and VTs of the same accuracy class as that of meters cannot be accommodated in the metering cubicle or panel due to space constraints, the CTs and VTs of the next lower accuracy class can be installed.

The voltage transformers shall be electromagnetic VT or capacitive voltage transformer (CVT).

Anti-tampering Features

(a) The meter shall not get damaged or rendered non-functional even if any phase and neutral are interchanged.

(b) The meter shall register energy even when the return path of the load current is not terminated back at the meter, and in such a case the circuit shall be completed through the earth. In case of metallic bodies, the earth terminal shall be brought out and provided on the outside of the case.

(c) The meter shall work correctly irrespective of the phase sequence of supply (only for poly phase).

(d) In case of 3 phase, 3 wire meter even if reference Y phase is removed, the meter shall continue to work. In the case of 3 phase, 4 wire system, the meter shall keep working even in the presence of any two wires, i.e., even in the absence of neutral and any one phase or any two phases.

(e) In case of whole current meters and LV CT operated meter, the meter shall be capable of recording energy correctly even if input and output terminals are interchanged.

(f) The registration must occur whether input phase or neutral wires are connected properly, or they are interchanged at the input terminals.

(g) The meter shall be factory calibrated and shall be sealed suitably before dispatch.

(h) The meter shall be capable of recording occurrences of a missing potential (only for VT-operated meters) and its restoration with date and time of first such occurrence and last restoration along with total number and duration of such occurrences during the above period for all phases.

Additional anti-tampering features including logging of tampers, such as current circuit reversal, current circuit short or open and presence of abnormal magnetic field may be provided as per the regulations or directions of the appropriate Commission or pursuant to the reforms programme of the appropriate government.

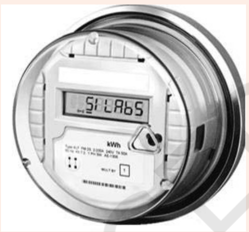
These days, meters have the technology to identify theft and log the tamper with date and time stamping.

These meters can keep record of large number of tampers, normally 200 tampers in three-phase meters and 100 tampers in single-phase meters. These meters are also programmed to record the energy at their maximum current rating under certain tamper condition to penalise the consumer or to discourage the consumer from attempting the theft.

Let's Revise 1

Indentifying Various Type of Meters

You can see various meters in Meter Testing Lab or Electrical store. Various types of meters are used for measuring the electrical energy being used at consumers' premises. Identify the types of meters shown below.



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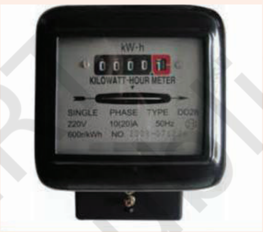

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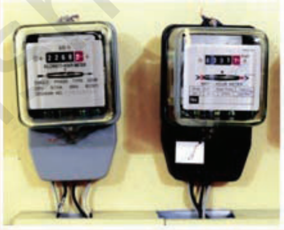

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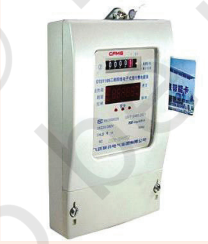

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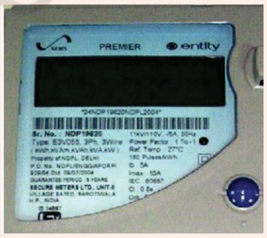

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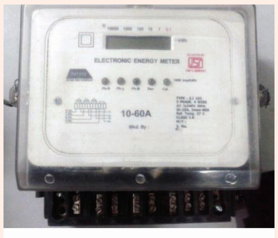

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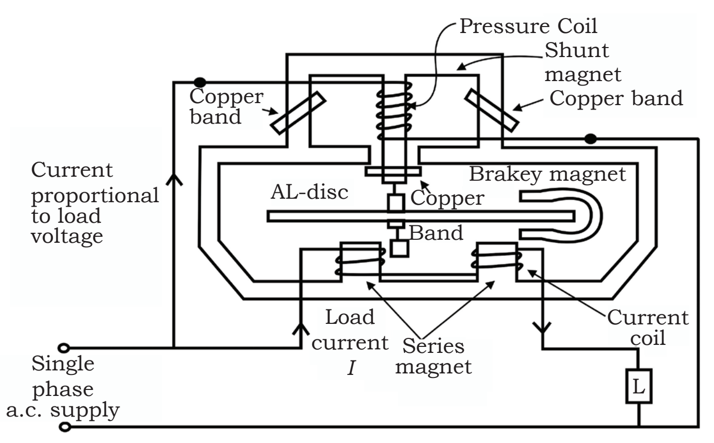
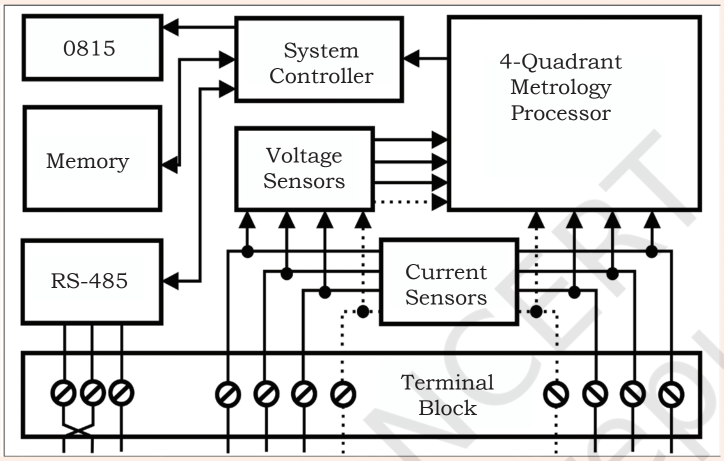
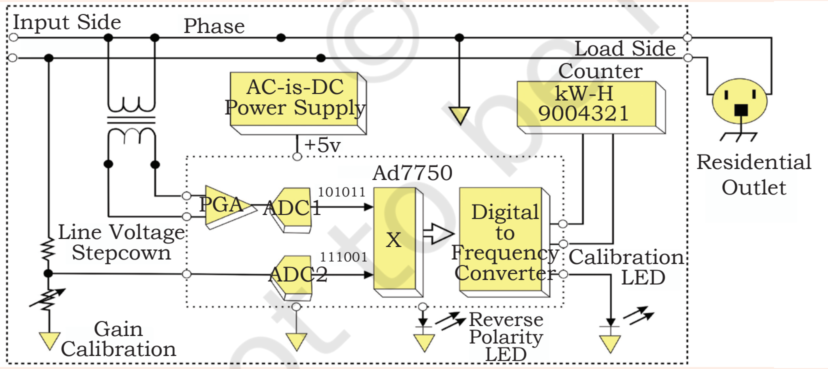
Components of Various Types of Meters

You can go in a Meter Testing Lab where meters are tested by opening them. You can see various components of meters like electromechanical meter, analog eletronic meters and digital electronic meters.







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Practical Procedure of Installation of Single-phase Energy Meter

First inspect the site where the meter is to be installed and observe the following:

(a) cable size is suitable as per load and the cable is open from pole to meter box.
(b) meter box is placed at the right place, i.e., at the door step and at visible height.
(c) earthing is provided or not and earth wire is of required size or gauge.
(d) no naked wire should be visible.

Procedure

(i) Now first wear the hand gloves and cut off the supply from the distribution box and discharge the line using discharge rod and hang the discharge rod in phase wire.
(ii) Put caution board in distribution box before starting the work. Now you have created a safe zone for work.
(iii) Now fix the single phase meter in a meter box and connect the outgoing phase and neutral as per the diagram shown in meter cover afterwards.
(iv) First, connect the incoming neutral wire in meter terminal and lastly the incoming phase wire.
(v) Tighten the screws of the meter terminals properly. Now put the meter cover or box cover. The premise is now ready for energisation, you can connect the neutral wire of cable to supply neural conductor or neutral in distribution box and then you can connect the phase wire to the line.
(vi) Remove earthing rod and caution board before switching on the supply.
(vii) Now you can check the supply in consumer premise and if you are satisfied with the workmanship and proper working of meter then you seal the meter using seal pliers and lead seal or any other seal.

Practical Procedure of Installation of Poly/3-phase Energy Meter

First inspect the site where the meter is to be installed and observe the following:

(a) cable size is suitable as per load and the cable is open from pole to meter box,
(b) meter box is placed at the right place, i.e., at the door step and proper visible height,
(c) proper earthing is provided or not and earth wire is of proper size/gauge and
(d) no naked wire should be visible.

Procedure

(i) Now first wear hand gloves and cut off the supply from the distribution box and discharge the line using discharge rod and hang the discharge rod in phase wire.

(ii) Put the caution board in the distribution box before starting the work. Now you have created a safe zone for work.

(iii) Now fix the Poly/3-phase meter in the meter box and connect the outgoing phase R, Y, B (three) and neutral.

(iv) First connect the incoming neutral wire in meter terminal and lastly the incoming phase wire R, Y, B (three). Ensure that the screws of the meter terminals are properly tightened. Now put the meter cover or box cover.

(v) The premise is now ready for energisation, you can connect the neutral wire of cable to supply neutral conductor or neutral in distribution box and then you can connect all the three (R, Y, B) phase wires to the line.

(vi) Remove the earthing rod and caution board before switching on the supply.

(vii) Now check the supply in consumer premise and if you are satisfied with the workmanship and working of the meter then you can seal the meter using seal pliers and lead seal or any other seal.

Procedure of Replacement of Single-phase Energy Meter

(i) First wear hand gloves and cut off the supply from the distribution box and discharge the line using discharge rod and hang the discharge rod in phase wire.

(ii) Put caution board in distribution box before starting the work. Now you have created a safe zone for work.

(iii) First remove seals provided in the terminal cover as well as meter box. Now unscrew the phase and neutral wire of incoming as well as outgoing from meter terminal. Next, remove the cable connection from terminal. Now you can remove the meter. If you have a meter for replacement then fix the single phase meter in meter box and connect the outgoing phase and neutral as per the diagram shown in meter cover afterwards.

(iv) First connect the incoming neutral wire in meter terminal and lastly the incoming phase wire.

(v) Tighten the screw of meter terminals. Now put the meter cover or box cover.

(vi) The premise is now ready for energisation, you can connect the neutral wire of cable to supply neutral conductor or neutral in distribution box.

Procedure of Replacement of Poly/3-phase Energy Meter

(i) First wear the hand gloves and cut off the supply from the distribution box and discharge the line using discharge rod. Hang the discharge rod in phase wire.
(ii) Put caution board in distribution box before starting the work. Now you have created a safe zone for work.
(iii) First remove the seals provided in the terminal cover as well as meter box. Now unscrew all the phases and neutral wire incoming as well as outgoing from meter terminal. Now remove the cable connection from terminal.
(iv) Next, remove the cable connection from terminal. And now you can remove the meter.
(v) If you have a meter for replacement then fix the poly/three-phase meter in meter box and connect the outgoing phase R, Y, B (three) and neutral as per the diagram shown in meter cover afterwards.
(vi) First connect the incoming neutral wire in meter terminal and lastly the incoming phase wire R, Y, B (three). Tighten the screw of the meter terminals. Now put the meter cover or box cover. The premise is now ready for energisation, you can connect the neutral wire of cable to supply neural conductor or neutral in distribution box and then connect all the three (R, Y, B) phase wire to the line.
(vii) Remove the earthing rod and caution board before switching on the supply.
(viii) Now check the supply at the consumer premise and if you are satisfied with the workmanship and proper working of meter then you can seal the meter using seal pliers and lead seal or any other seal.

Check Your Progress

A. Fill in the Blanks

1. The LED indicating REV will be blinking in case of tamper or unusual conditions when there is a ____________ flowing through the meter.
2. It is mandatory for a Consumer Energy Meter Technician to wear __________ and to prepare a safe zone for work.
3. Potential transformer is used in an electrical power system for stepping down the system voltage to a _________________ which can be fed to low rating meters and relays.

B. Multiple Choice Questions

1. For consumer meters _____________.
    - (i) it is the responsibility of the licensee to record the metered data.
    - (ii) the licensee shall maintain accounts for the electricity consumption.
    - (iii) the licensee shall provide real time display unit at the consumer premises.
    - (a) all of the above
    - (b) Only (i) and (iii)
    - (c) Only (i) and (ii)
    - (d) Only (iii)
2. Which of the below mentioned characteristics of the seal used is/are correct?
    - (i) Seal is not a lock
    - (ii) Seals are used to detect unauthorised entry
    - (iii) Seals are a means of security and safety for meters
    - (iv) Seals can be made of lead, metal, engineering plastic, etc.
    - (a) Only (iii)
    - (b) Only (i) and (iv)
    - (c) Only (i)
    - (d) Only (iv)